SECTION 511

PNEUMATICALLY APPLIED CONCRETE

511.1 GENERAL

Pneumatically applied mortar or concrete, designated herein as gunite or approved equal, shall consist of premixed sand and portland cement pneumatically transported in a dry state to a nozzle where hydration takes place immediately prior to expulsion.

511.2 REFERENCES

511.2.1 ASTM
C 39
C 42

511.2.2 This publication
SECTION 105

511.3 EQUIPMENT

511.3.1 The cement gun should be operated at a minimum air pressure of 45 pounds per square inch on the gun tank when 100 feet or less of material hose is used, and the pressure should be increased 5 pounds for each additional 50 feet of hose required. Nozzles used for applying the material shall have a maximum size of 1 5/8 inches unless otherwise permitted by the ENGINEER.

511.3.2 Water used for hydration shall be maintained at a uniform pressure, which shall be at least 15 pounds per square inch above air pressure at the gun.

511.4 PROPORTIONS AND MIXING

Unless otherwise specified, the material shall consist of a mixture of cement and sand in the proportions, by volume, of 1 part of cement to 4 1/2 parts sand. The sand and cement shall be thoroughly mixed in a power mixer for at least 1 1/2 minutes before placement in the chamber of the gun. The dry mixed material shall be used promptly after mixing, and any material that has been mixed for more than 45 minutes shall be wasted.

511.5 TESTS

511.5.1 During the applicaton of the material, the CONTRACTOR shall cooperate with the ENGINEER in making compressive tests required to determine the quality of the material being placed in the work. The tests shall be conducted in conformity with the requirements of ASTM C 39. Test specimens shall be made so as to represent the quality of material being placed in the work by each nozzleman and shall consist of 6 inches x 12 inches cylinders made by shooting the material vertically into cylindrical cages of 1/2 inch mesh hardware cloth mounted on a board. The material outside the mold should be removed immediately after shooting the specimen so that the wire mesh can be detached before testing. The number of test specimens to be taken shall be as provided in the Supplementary Specifications or as determined by the ENGINEER. Separate test specimens made at the same place and time shall be tested at the age of 7 and 28 days. The specimens at the age of 7 days shall develop a minimum compressive strength of 2,400 pounds per square inch, and at the age of 28 days the specimens shall develop a minimum compressive strength of 3,500 pounds per square inch unless otherwise specified herein. In lieu of the above tests, the ENGINEER may elect to perform core tests. A minimum of 3 cores shall be taken for each 250 cubic yards or fraction thereof of material deposited.

511.5.2 Cores shall be obtained and tested in accordance with ASTM C 42. One core shall be removed and tested at an age of 14 days, the other 2 cores at an age of 28 days. Fourteen day cores shall develop a minimum strength of 2,200 psi. Twenty-eight day cores shall develop a minimum strength of 3,000 psi unless otherwise specified herein.

511.5.3 If the cores show deficient strength, additional cores shall be taken at the CONTRACTOR's expense from adjacent areas. Two cores shall be required for each deficient core. Should such deficiency be evident in 14 day cores, on approval of the ENGINEER, the CONTRACTOR may proceed with the work on his own responsibility until the 28 day cores are tested.

511.5.4 Where conditions preclude the possibility of obtaining cores from the material in place, the ENGINEER may approve cores taken from a respresentative test panel made at the same time and under the same conditions as the material being placed in the work.

511.6 PLACEMENT

511.6.1 Earth surfaces to which the material is to be applied shall be neatly trimmed to line and grade and shall be free of all loose material. The surface need not be compacted by slope rolling or other measures unless required by the plans or Supplementary Specifications.

511.6.2 No high subgrade will be permitted and excavation made below subgrade shall be backfilled with compacted fill or, at the CONTRACTOR's option, with

the material. However, no additional compensation will be allowed for such compacted fill nor for increased thickness of material placed on account of low subgrade.

511.6.3 Asphaltic concrete surfaces shall be thoroughly cleaned of any growth, silt and clay, or any other material detrimental to the material and then washed with water under pressure.

511.6.4 Masonry, rock, and concrete surfaces shall be examined and all loose material removed therefrom. The surface shall be thoroughly cleaned with steel scrapers or brushes to remove all dust, dirt, mortar, grease, or other deleterious substances and then washed with water.

511.6.5 Whenever brushing and scraping do not secure suitable results, sandblasting may be required.

511.6.6 All surfaces shall be wetted with water before application of the material, and no material shall be applied to surfaces on which free water exists.

511.6.7 The velocity of the material as it leaves the nozzle shall be maintained uniformly at a rate determined for given job conditions. Material which rebounds and does not fall clear of the work or which collects on the surfaces shall be blown off or otherwise removed. Rebound shall not be used in any portion of the work, and no pavement will be incorporated for rebound or other losses.

511.6.8 The nozzle shall be held at such distance and position that the stream of flowing material will impinge at approximately right angles to the surface being covered. Any portions of the placed material which tend to sag or which show soft or sandy pockets or are otherwise unsatisfactory shall be cut out and replaced. Reinforcement thus damaged or destroyed shall be replaced by trimming back and properly lapping and tying, to the satisfaction of the ENGINEER.

511.6.9 Reinforcement shall be firmly supported in the position shown on the plans. Mortar blocks, metal chairs, clips, or spacers with wire ties or other acceptable means shall be used to properly anchor and place the reinforcement.

511.6.10 Where material is placed on overhead surfaces, the amount of water used shall be so adjusted that approximately 3/4 inch of the placed material shall adhere without support. The limit of thickness has been exceeded when the material begins to sag or slough.

511.7 FORMS AND GROUND WIRES

511.7.1 The forms shall be built in accordance with applicable provisions of the specifications, except all forms shall be built so as to permit the escape of air and rebound.

511.7.2 Ground wires shall be installed in such manner that they accurately outline the finished surface as indicated on the plans. They shall be located at intervals sufficient to insure proper thickness throughout. Wires shall be stretched tight and shall not be removed prior to application of the finished coat.

511.7.3 Headers will be required where the plans indicate a formed edge and at plan joints.

511.8 JOINTS

511.8.1 Construction joints shall be sloped off at an angle of approximately 45° to the surface being shot. Before shooting the adjacent sections, the sloped portion shall be thoroughly cleaned and wetted by means of air and water blast.

511.8.2 The plan joint shall be formed in accordance with and placed in the locations as designated on the plans.

511.9 FINISH

511.9.1 Upon reaching the thickness and shape outlined by forms and ground wire, the surface shall be rodded off to true lines.

511.9.2 Any low spots or depressions shall be brought up to proper grade by placing additional material. Ground wires shall then be removed; and unless otherwise specified, the surface shall then be broom finished to secure a uniform surface texture. Rodding and working with a wood float shall be held to a minimum.

511.9.3 Rebound or accumulated loose sand shall be thoroughly cleaned up and disposed of to the satisfaction of the ENGINEER. In no case shall it be floated into the surface of the work.

511.9.4 When a nozzle finish is specified on the plans, ground wires shall not be used and the surface shall be left as uniform as possible without rodding. Nozzle finishes will not be permitted where the underlay has been floated.

511.10 CURING

511.10.1 The pneumatically placed material shall be cured as prescribed for concrete curing, Section 105.

511.10.2 The CONTRACTOR shall at all times protect the finished work from being scarred or damaged in any way.

511.11 MEASUREMENT AND PAYMENT

Measurement for pneumatically placed concrete will be made in conformity with the terms of the Contract and will be based on units and/or quantities as set forth in the Bid Proposal. Such payment shall be full compensation for furnishing all labor, materials, tools, and equipment and doing all work required to complete the Work in conformity with the plans and specifications.